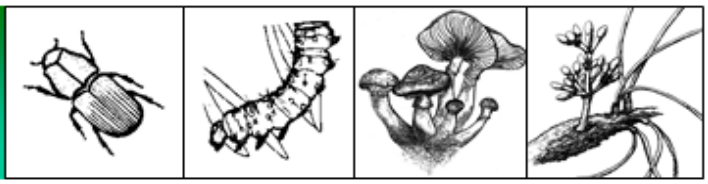
Forest Health Protection



17-04 *MARCH, 2017*

Evaluation of Management Techniques to Reduce Sequoia Pitch Moth Damage at Bigfork and Plains Tree Improvement Areas

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Sequoia pitch moth, *Synanthedon sequoiae* (SPM), can cause significant damage to primarily lodgepole and ponderosa pine trees growing in seed orchards and tree improvement areas, and occasionally in natural forest settings. Management options for SPM in high-value seed orchards are limited. Insecticides have not proven useful in controlling attacks by SPM. Control efforts are mainly accomplished by manually removing larvae from pitch masses on individual trees which is very labor intensive and only partially effective. SPM has a two-year life cycle in Montana and any control method applied needs to be done at a minimum for two-years.

Two alternative control methods–providing a physical barrier with tree wrap and pheromone trapping–were tested at Bigfork Tree Improvement Area (TIA) in 2014 and 2015. Both treatments reduced SPM activity and damage (Sturdevant et al. 2016). The objectives of this study were to evaluate: 1) a third year of trapping in the same treatment block used in the 2014 and 2015 studies at Bigfork TIA, 2) trapping in lodgepole pine at a new location-Plains TIA, and 3) to determine if the new type of tree wrap applied in 2015 at Bigfork TIA remained an effective physical barrier-2 years post application.

Methods

Field experiments at Bigfork TIA were conducted in three lodgepole pine plantations growing in 2-acre blocks. The wrapping study block contained both treatment and control trees; the trapping study was implemented in separate treatment and control blocks. Blocks were located about ¼ to ½ miles apart from each other and were the same treatment blocks that were used in the 2014 and 2015 study (Sturdevant et al. 2016). All three blocks

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contained 175 or 178 lodgepole pine trees of similar size. At the Plains site, the field experiment was conducted in two lodgepole pine plantations located approximately ½ mile apart. There are 230 lodgepole pines in the 2-acre trapping block and 67 in the 1-acre control block (these blocks were the only ones available for inclusion in this study). Trees in both blocks were of similar size.

Tree Wrap

Sixty trees were selected in one of the lodgepole plantation blocks at Bigfork in June of 2014 and randomly assigned to either treatment or control (n = 30). The tree wrap was evaluated in the fall of 2014. In June of 2015, the original tree wrap was removed because it was deteriorating, all pitch masses were removed again from both control and treatment trees and the current study was begun in which a new wrap (Tangle Guard Banding material from Contech Inc.) was applied to treatment trees. In August 2016 after moth flight, number of new pitch masses on the control and wrapped trees were assessed.

Trapping

In the spring before SPM flight and again in late August after moth flight, 2016, trapped and control blocks were assessed for SPM population levels at Bigfork and Plains. Fifty trees at Bigfork and 30 trees at Plains were systematically selected (every 4-6th tree) in the trapping and control blocks and evaluated for new pitch masses on tree boles (up to 4.5 feet above the ground).

On May 2, 2016, 24 pheromone baited delta traps (0.5 mg of ZZ-3, 13-18OH) were placed in each of the trapping blocks on an evenly-spaced grid (approximately every 40 feet) except for in rows along the perimeter of all four sides at Bigfork and Plains. Traps were checked bi-weekly for moths from May 15 through August 1 and number of moths found was recorded. Pheromone baits were replaced mid-season on about July 1.

Statistical Analysis

For the tree wrap experiment at Big Fork TIA we compared the number of pitch masses in trees that were wrapped to the control trees using a *t*-test (Microsoft® Excel® 2013, Analysis ToolPac Add-in). The late summer comparison used the *t*-test assuming unequal variances. For the Bigfork trapping experiment we compared the number of pitch masses on select trees in the treatment and control blocks with a *t*-test assuming unequal variances (Microsoft® Excel® 2013, Analysis ToolPac Add-in). Variances were compared using Two-Sample F-test for Variance (Microsoft® Excel® 2013, Analysis ToolPac Add-in). For all statistical tests an alpha of 0.05 was used.

At Plains, before adult egg laying occurred, we recorded 100 pitch masses in the trapping block versus 279 pitch masses in the control block on thirty trees in each block. We were unable to find two blocks with similar levels of pitch masses on individual trees. In August, 58 pitch masses were recorded in the trapping block verses 277 in the control block on each of 30 trees respectively. Because of the significant difference in pitch mass levels between the treatment and control blocks prior to treatment we decided to drop the control block from further analysis. We only compared the difference in pitch masses on the 30 trees selected in the treatment area pre- and post-treatment using a *t*-test.

Results

Trapping

A total of 120 moths were caught at Bigfork and 175 moths were caught at Plains in the 24 traps at each site. Trap catches peaked on June 15 at Bigfork and Plains but a second peak occurred at Bigfork on July 22. First moths were caught the 4th week in May at Bigfork and the first week in June at Plains. No moths were caught after August 1 at either site (Figure 1).

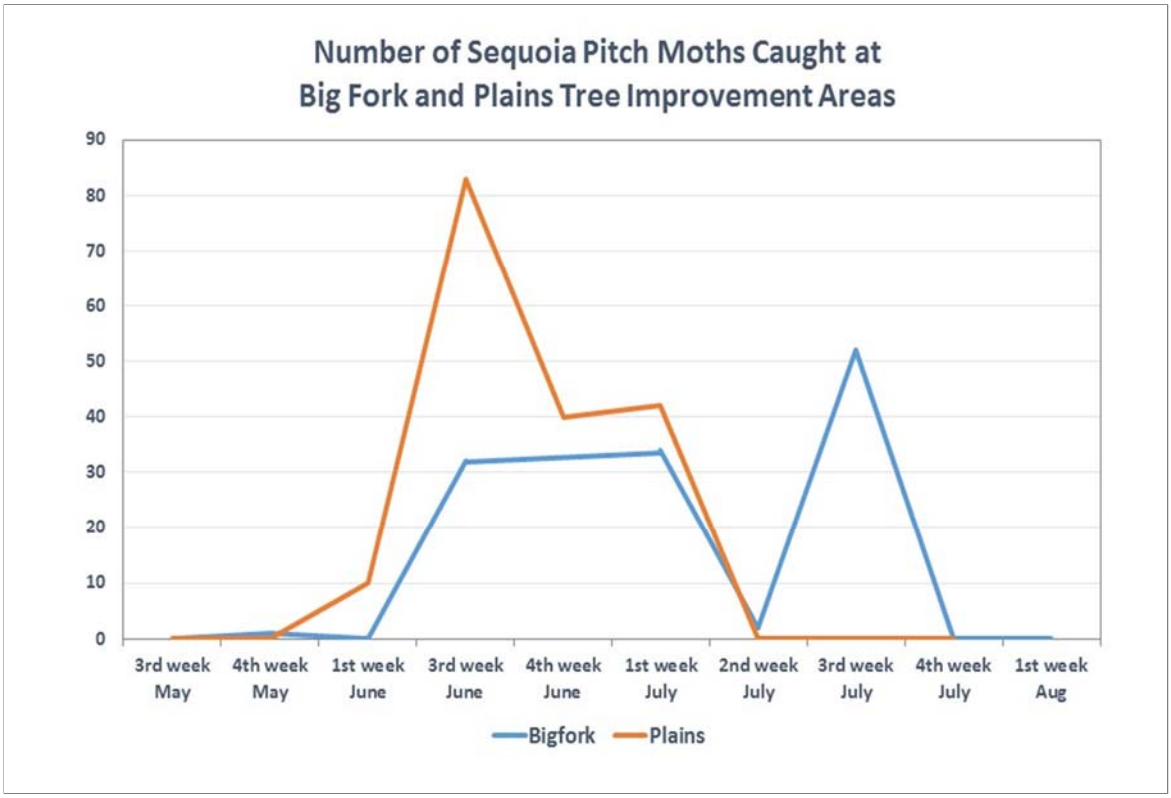

Figure 1. Number of sequoia pitch moths trapped during 2016 at Bigfork and Plains TIAs.

Big Fork Trapping Experiment

At Bigfork**,** before adult egg laying occurred, we recorded 69 pre-treatment 2015 pitch masses in the trapping block versus 188 pre-treatment 2015 pitch masses in the control block on 50 trees at each location respectively. Fewer number of pitch masses in the treatment versus control block is most likely related to multiple years of trapping at this site. In 2014 pitch masses were at similar levels in the control and treatment blocks (Sturdevant et al. 2016). In August (post flight), 59 pitch masses were recorded in the trapping block and 176 in the control block (Table 1).

Table 1. Numbers of pitch masses in trapping and control blocks at Bigfork and Plains tree improvement areas.

	Bigfork (n=50)		Plains (n=30)	
	Trapping Block	Control Block	Trapping Block	Control Block
2014 Pitch Masses (pre-treatment)	224	240	N/A	N/A
Pre-flight Pitch Masses (2016)	69	188	100	279
Post-treatment Pitch Masses (2016)	59	176	58	277

Similar to our test in 2015, we continued to see significant differences in number of pitch masses per tree between the trapping and control blocks in June 2016 (Trapping = 1.4 pitch masses/tree, Control = 3.8 pitch masses per tree; t = -5.1, $P < 0.0001$) and August 2016 (Trapping = 1.2 pitch masses/tree, Control = 3.5 pitch masses per tree; t = -5.9, $P < 0.0001$).

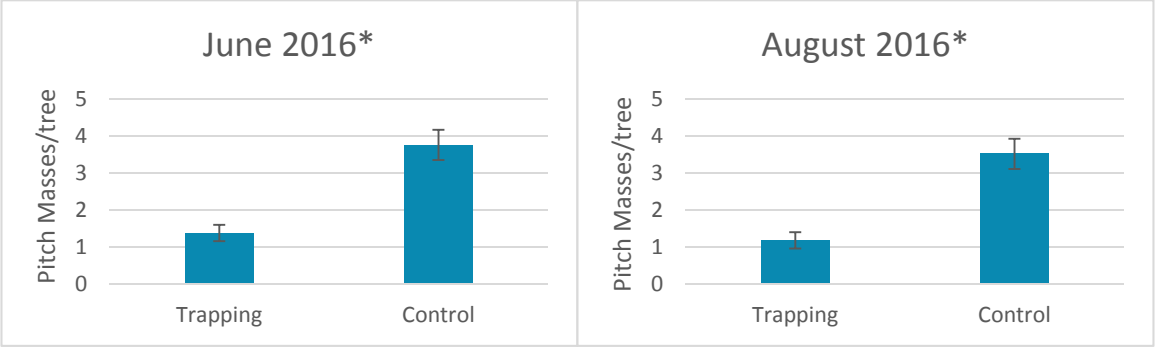

*Figure 2. Differences in the pitch masses per tree between trees in the trapping and control plantation blocks in the Big Fork Trapping experiment in early and late summer. Error bars equal one Standard Error of the Mean. *statistically significant differences*

Plains Trapping Experiment

There was a significant difference between the mean number of new pitch masses per tree in the trapping block in the spring prior to treatment (April = 3.3 pitch masses per tree) and late summer after moth flight (September = 1.9 pitch masses per tree; t = 2.4, $P < 0.01$). In 2017, we will continue to monitor pitch masses in the treatment and control blocks to follow trends, however, we will only analyze pre and post treatment effects in the trapping block.

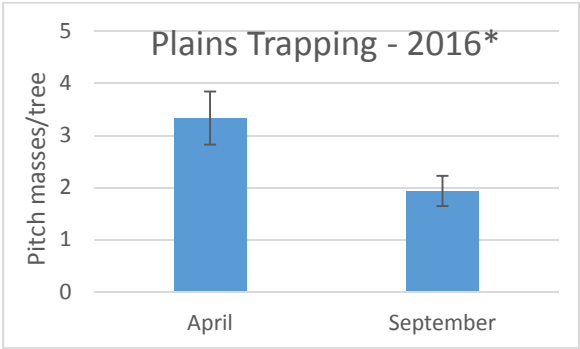

*Figure 3. Comparison of the number of pitch masses per tree in April and September, 2016, measurements. Error bars equal plus or minus one standard error of the mean. *significant difference.*

Tree Wrap

There was no significant difference in the pitch masses per tree in June 2016 (before SPM flight) of the Tree Wrap Experiment (Wrap = 0.37 pitch masses/tree, Control = 0.6 pitch masses/tree; t = -1.01, P = 0.16). There were, however, significantly fewer pitch masses per tree on the wrapped trees compared to the control trees in the August 2016 (after SPM flight) measurement (Wrap = 0.77 pitch masses/tree, Control = 1.83 pitch masses/tree; t = -2.4, P = 0.01) (figure 5).

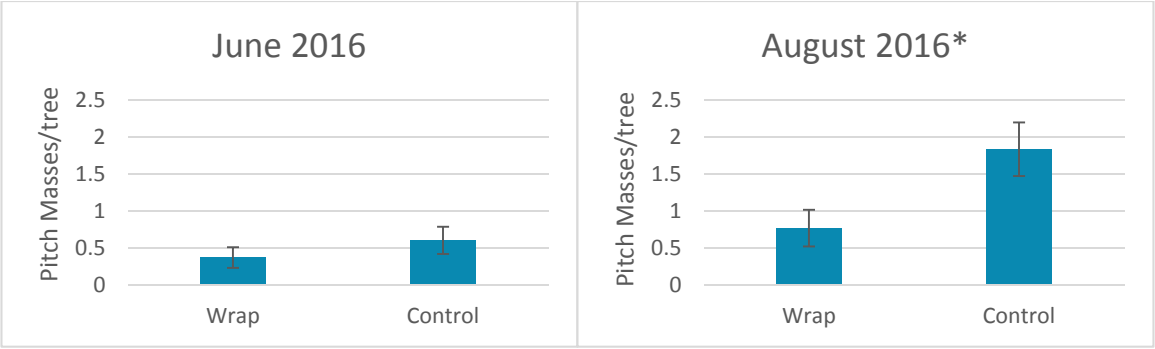

*Figure 5. Differences in pitch masses per tree between the treatment and control in the Big Fork Tree Wrap experiment before and after moth flight and oviposition in 2016. Error bars are plus or minus one Standard Error of the Mean. *statistically significant difference*

Discussion

Total number of pitch masses found on trees in the trapping blocks at Bigfork and Plains decreased over time, but only slightly decreased in the control block at Bigfork and stayed about the same in the control block at Plains (figure 4).

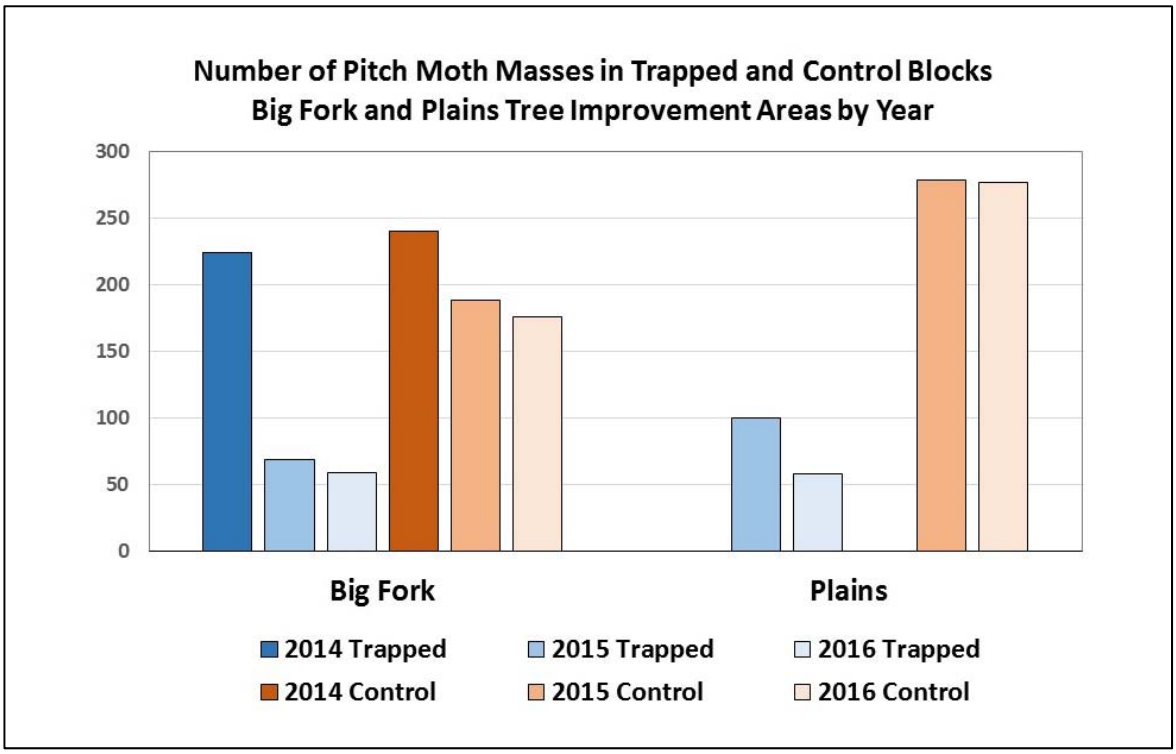

Figure 4. Trend data for number of pitch moth masses in trapped and control blocks over time at Bigfork and Plains Tree Improvement Areas. Pitch masses in 2014 at Bigfork were pre-trapping in 2015. 2015 pitch masses were pre-trapping in 2016. 2016 numbers are post trapping in 2016.

Wrapping trees significantly reduced new attacks by SPM at the Bigfork TIA. The tree wrap, reduced SPM damage on wrapped trees post treatment compared to controls. However number of pitch moth attacks on wrapped trees did increase between treatment years one and two. We suspect that the tree wrap did act as a physical barrier reducing SPM oviposition on wrapped trees but did not prevent some larvae from chewing through the

tree wrap which allowed them to continue to feed in the cambium and produce associated pitch. Some new attacks also occurred near branch crooks (figure 6).

Figure 6. Sequoia pitch moth pitch masses on a wrapped tree at Bigfork Tree Improvement Area.

Tree wrapping for SPM control is more time intensive than trapping. However, it appears that the Tangle Guard wrap is durable and effective. Trapping needs to be done annually but is effective and requires less time than wrapping individual trees. The total number of pitch masses in the trapping block over the three-year trapping period continued to decline at Bigfork while the total number in the control block only slightly decreased. If the trend of reduced masses each year of trapping continues, then using pheromone traps over the long term may result in less damage on individual trees than protecting them with tree wrap. Also, trapping affords protection for all trees in the trapping block versus individual trees that are wrapped.

In 2017, we will continue to evaluate trapping at Bigfork in treatment and control blocks to determine if long-term, operational trapping is an effective method of reducing impacts from SPM. At Plains, we will continue to trap in the treatment block and compare number of pitch masses on 30 trees in the trapping block pre- and post-treatment for the second year. Prior to trapping, all pitch masses will be marked on treatment trees in control and trapping blocks in 2017. We are also planning on increasing the dose of the pheromone lure at both locations in an attempt to increase trap catches and reduce subsequent damage based on the results of a 2016 study that showed trap catches increased with increasing pheromone dose (Kegley et al. 2017).

References

Kegley, S.; Sturdevant, N. 2017. Pitch Moth Response to High Dose Pheromone Lures in Western Montana. **Rep.** 17-03. U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection. 4 p.

Kegley, S.; Sturdevant, N. 2016**.** Effect of Trap Type on Pitch Moth Trapping in Western Montana. Rep.16-04. U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection. 5 p.

Sturdevant, N.; Kegley, S.; Crane, B.; Hayes, C. 2015. Evaluation of two control methods for reducing damage from sequoia pitch moth, Big Fork Tree Improvement area, Flathead National Forest, Montana. Rep.15-07. U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection. 7 p.

Sturdevant, N.; Kegley, S.; Crane, B.; Hayes, C. 2016. Evaluation of Trapping and Tree Wrapping as Management Tools to Reduce Damage from Sequoia Pitch Moth at the Big Fork Tree Improvement Area. Rep.16-06. U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection. 4 p.